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James Hall Vegetated Roof Nutrient Removal Efficiency and Hydrologic Response

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Basic Information

Title:	James Hall Vegetated Roof Nutrient Removal Efficiency and Hydrologic Response
Project Number:	2012NH168B
Start Date:	3/1/2012
End Date:	2/28/2014
Funding Source:	104B
Congressional District:	01
Research Category:	Water Quality
Focus Category:	Nutrients, Water Quality, Treatment
Descriptors:	
Principal Investigators:	Robert Roseen, Thomas P. Ballestero

Publications

There are no publications.

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Project Type: BMP Water Quality and Effectiveness Research
Focus Categories: Effects of urban development and storm water runoff on surface water quality, Non-point source pollution, BMP effectiveness, Education outreach
Keywords: Vegetated Roof, Environmental Education, Water Resources
Project Duration: March 1, 2012 to February 28, 2014 (1 year + a 1 year no-cost extension)

***Agency Funding Requested*:** $7,000.00 Matching Funds: $14,000.00

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Background: The University of New Hampshire Stormwater Center (UNHSC) has been contracted to examine the water quality and hydrologic performance of a EPDM rubber flat compared to that of a vegetated roof. Currently, vegetated roofs are not widely used within New England as a common stormwater Best Management Practice (BMP). However, the incorporation of vegetated roofs into a region's stormwater management plan may be an efficient method of managing flooding issues and reducing nutrient loading to already impacted surfaces waters.

Statement of Critical State Issues: NH faces a host of water resource-related issues, including flooding, drought, non-point source pollution, Lake Eutrophication, erosion and sedimentation, and climate change. Each of these can be related to stormwater runoff and the environmental consequences and management responses. Conventional strategies for managing stormwater discharge such as traditional storm drains and ponds have typically been ineffective at removing nutrients from stormwater runoff. The adverse effects of nutrient pollution on water quality are well documented in state water quality assessments (NITG 2009). The relationship between nitrogen loading, background or historical nitrogen concentrations and dissolved oxygen levels is complex and requires calibrated models to help manage excessive loads (NYSDEC, CTEPA 2000). There is a need to understand the role various Best Management Practices have for nutrient removal in order to help develop estuarine watershed management plans and quantify the impact of the stormwater component of estuarine nitrogen Total Maximum Daily Loads (TMDLs). Total nitrogen is more complex than TSS, Total Phosphorus (TP) and metals because it is not tightly bound to particulates, exists in dissolved inorganic forms, can pass through typical stormwater BMPs, and potentially be introduced into groundwater, stream baseflows and estuarine or coastal waterbodies (PREP 2009).

BMPs have mixed success at removing nitrogen from stormwater. Two primary mechanisms are observed for treatment of nitrogen in stormwater runoff including 1) adsorption and uptake by vegetated systems (Davis et al 2009), and 2) anaerobic microbial conversion of nitrate to nitrogen gas (Brown and Hunt 2010, Roseen et al 2010). The first mechanism is determined largely by filter media composition, and the second mechanism largely by system configuration and drainage. Traditional stormwater technologies (ponds, swales, hydrodynamic separators) do little to address nitrogen pollution with removal performance observed from zero to at most 33%. Whereas vegetated filter systems, including green roofs, subsurface gravel wetlands, bioretention basins, can have a removal performance as high as 40-95% but are infrequently employed. Bioretention systems are becoming more common as they are relatively simple to build, and provide excellent removal for many stormwater contaminants, including suspended sediments, metals, and hydrocarbons. Tremendous performance variations are observed for different filter medias. Positive nitrogen removal is observed in media systems with low infiltration capacity and low sand content, and neutral or even negative treatment is observed from media with high sand and/or compost contents (FAWB 2008, Davis et al 2009, UNHSC 2010). There is a trend toward the use of rapidly draining medias because they enable smaller filter beds and ultimately reduced cost for construction, however they may be doing little for nitrogen removal. Importantly, filtration medias that are successful at removing nitrogen generally cannot exceed ~40-60% removal from adsorption and vegetative uptake alone.

Statement of Results and Benefits (Research Update):

Limited access and turnover in project staff have delayed deployment of research instrumentation. Installations will be secured over the next reporting period and samples collected analyzed and results interpreted.

Updated Timeline

Timeline:

Task Description	***Start***	***End***	***Status***
Site Assessment	3/1/2013	3/15/2013	Complete
Installation	3/15/2013	4/15/2013	to be completed by 6/15/2013
Initial Sampling	6/15/2013	8/1/2013	On time
Sampling	10/1/2013	1/30/2014	On time
QA/QC and Data reduction	2/1/2014	2/15/2014	On time
Final Report	2/15/2014	2/28/2014	On time

Methods, Procedures, and Facilities:

Research will utilize existing infrastructure within James Hall that splits roof runoff into flat roof and vegetated roof drainage pipes. These piping networks will be employed to sample storm events. Sampling will trigger when an appropriate flow rate is achieved. Once triggered 100 ml aliquots samples will be withdrawn on a flow weighted basis. Every 10 aliquots will be composited within one bottle to represent a specific portion of a storm event. Monitoring equipment from the UNHSC will be used. Storm samples will then be analyzed and further composited to best reflect each storm event. These flow weighted composite samples will then be sent for analysis to the UNH Water Quality Analysis Lab. Hydrologic and analytical results obtained from the laboratory will be evaluated and compiled into a tabular format for further investigation.

Analytical Methods: Analytical testing of water samples will include: total nitrogen and subspecies, total phosphate and subspecies. Analytes and methods are delineated in Table 1. In addition to those analytes listed below, real-time parameters will include pH, dissolved oxygen, conductivity, temperature, turbidity, and flow. Analytical and methods procedures are outlined in the UNHSC Quality Assurance Project Plan, available upon request.

Table 1: Analytes and Analytical Methods.

ANALYTE	METHOD
Nitrate/Nitrite in water	EPA 300.0A
TKN	ASTMD359002A
Ammonia (NH3)	SM4500NH3-D
Total Nitrogen	SM 2540 D
Total Phosphorus	EPA 365.3
Ortho-Phosphate	EPA 300.0A

Expenditures:

To date funds have been used to support staff in developing the research design investigating monitoring locations and setting up equipment. Earnings to date include:

James Houle: $1,890.75
Tim Puls: $1,433.36